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US Army Engineering and Support Center, Huntsville



I DRANK THE KOOLAID... NOW WHAT? MIS AFTER TWO YEARS

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Environment, Energy & Sustainability
Symposium & Exhibition

4-7 May 2009

Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE MAY 2009		2. REPORT TYPE		3. DATES COVERED 00-00-2009 to 00-00-2009	
4. TITLE AND SUBTITLE I Drank the Koolaid...Now What? MIS After Two Years				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) US Army Engineering and Support Center, Huntsville,Environmental and Munitions CX,Huntsville,AL,35807				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Presented at the NDIA Environment, Energy Security & Sustainability (E2S2) Symposium & Exhibition held 4-7 May 2009 in Denver, CO.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 32	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			



INTRODUCTION

- Multi-Increment Sampling 101
- Decision/Sampling Units
- Risk Assessment Issues
- Laboratory Issues
- Regulatory “Interferences”
- Summary



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MULTI-INCREMENT SAMPLING 101



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APPENDIX A to SW846

METHOD 8330B





WHAT IS MIS?

- Pooling of several individual increments from within the decision unit (can you say “composite”????)
- Intended to provide a more reliable estimate of the AVERAGE concentration
- Collection of field replicate samples (typically three) to provide an estimate of total uncertainty (RSD, RPD, 95% UCL)



SAMPLING ERRORS

- **Compositional heterogeneity**: not all particles within a population have the same concentration of target analytes
 - Maximum when analyte is present as a few discrete particles of pure material
- **Distributional heterogeneity**: contaminant particles scattered across the site unevenly
 - Maximum when a single discrete sample is used to estimate the mean for a large area



MIS CONSIDERATIONS

- What should the sample mass be to overcome compositional heterogeneity?
 - 1 kg or more
- How many increments are necessary to overcome distributional heterogeneity within the decision unit?
 - 30 grabs or more
- How large of an area can be adequately characterized with a multi-increment sample?
 - Decision unit is typically 25 to 10,000 m² (~2.5 acres)



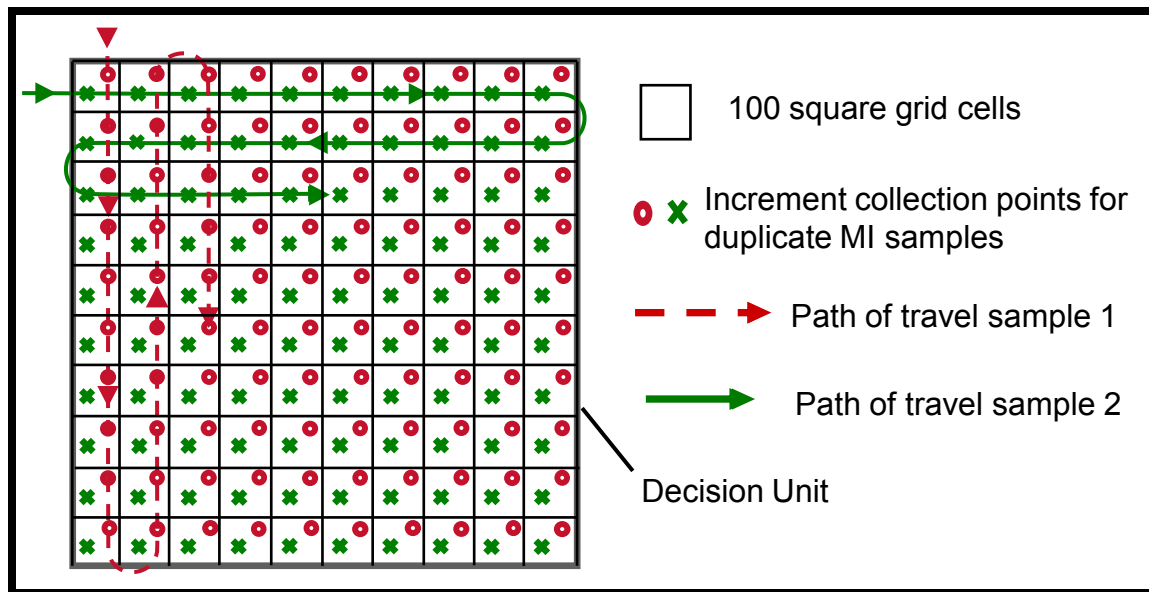
MIS CONSIDERATIONS

- How is decision unit established?
- What should the sampling depth be?
- Field work requires anomaly avoidance
- What are appropriate “action levels” based on multi-incremental samples?
- Required by Army MMRP RI/FS guidance (draft)



MIS CONSIDERATIONS

- How should increments be collected?
 - Systematic-random sampling design
 - Collection of replicate samples



Systematic Random Sampling for collection of duplicate 100-increment MI samples (Figure after CRREL, 2007). Nomenclature per Pitard, (1993, Figure 21.8); CRREL; and EnviroStat, Inc. There are nomenclatural differences in increment collection schemes between those and EPA 1995 (540/R-95/141) and EPA 1989 (EPA/230/02-89/042).

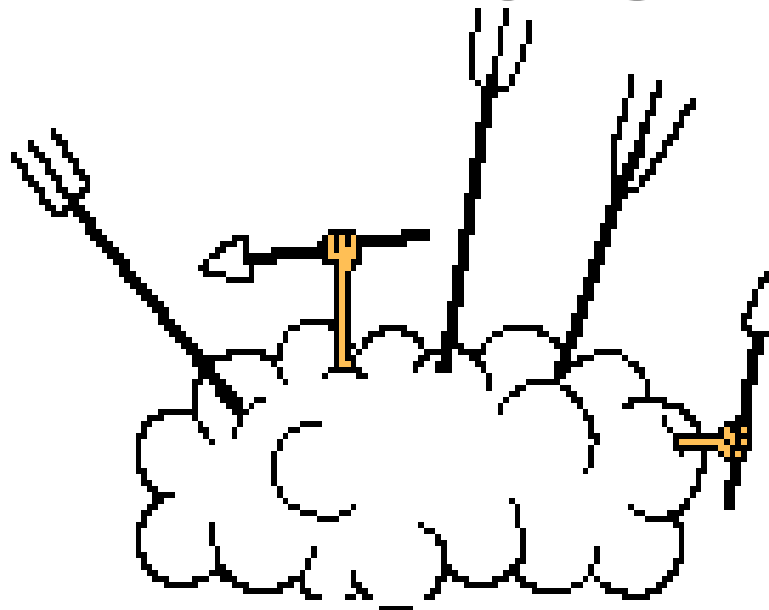


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DECISION UNITS and SAMPLING UNITS





DECISION UNITS

- Per the theory of MIS, **ALL** areas within a DU must have an equal chance of being sampled...the DU ***should not contain*** areas that have no chance of being sampled.
- New definition: “SAMPLING UNIT”



SAMPLING/DECISION UNITS

- The specific volume of soil (i.e. the population) for which MIS is used to obtain a representative estimate of the mean concentration of a constituent of concern (USACE, 2008)
- An area where a decision is to be made regarding the extent and magnitude of contaminants with respect to the environmental concerns posed by the contaminants (HDOH, 2008)



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DALHART PBR, TX

FUDS MMRP SI

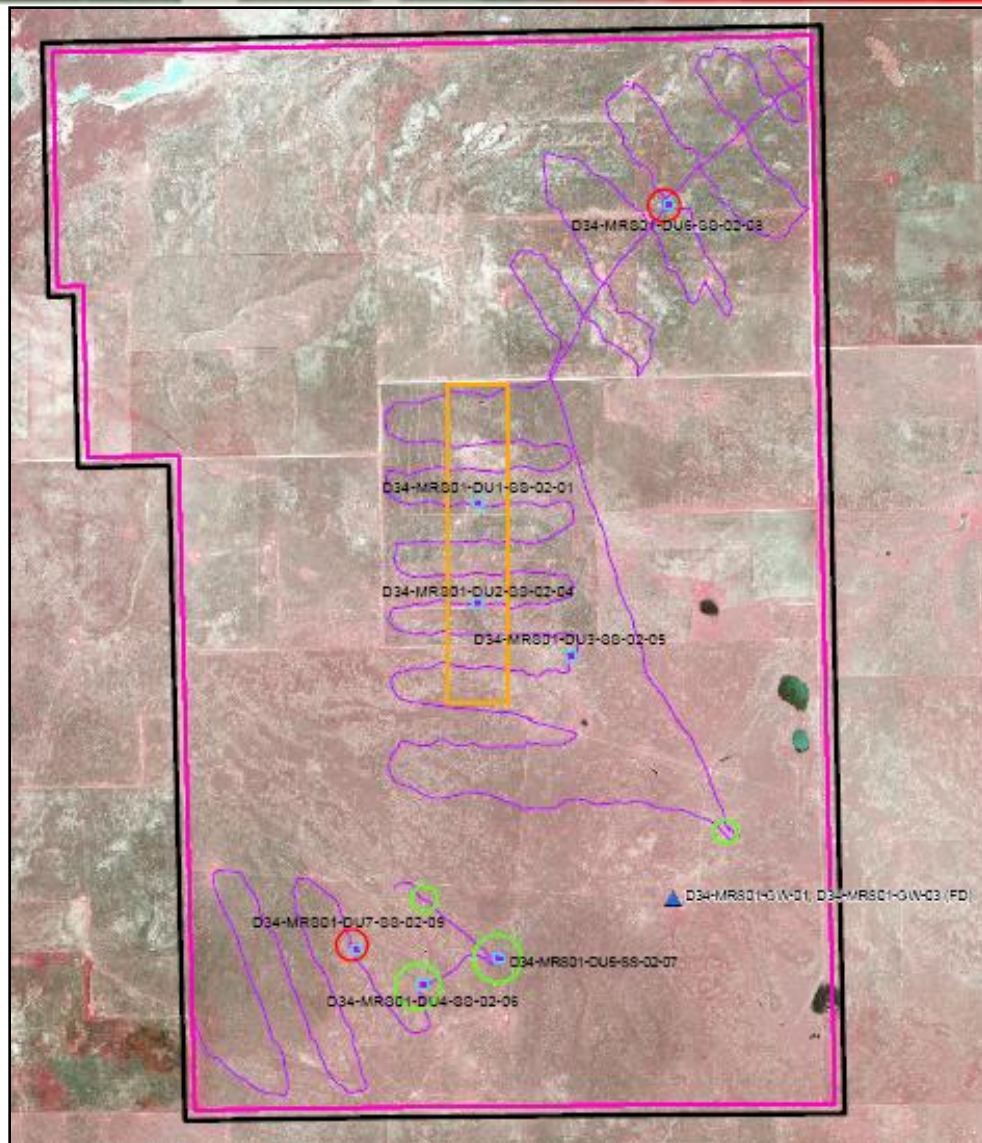


- Soil samples were collected from eight DU locations at Dalhart PBRs 3 and 4. Seven of these DU locations were selected to represent areas with the ***highest likelihood for the presence of MEC or MC contamination***, and one DU location was selected for an ambient soil sample.



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DALHART PBR, TX



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RISK ASSESSMENT ISSUES





RISK ASSESSMENT ISSUES

- Vegetation included (normally removed)
 - Analytical interferences?
- Samples are taken at 0-2" (Method 8330B)
 - Normally 0-6" or 0-12" (surface soil)
 - Introduces high bias for the exposure point concentration (EPC)
- Developed for surface soil sampling
 - Applicable to subsurface soil sampling?



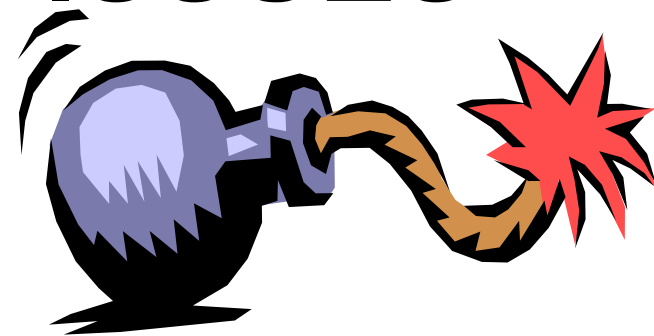
RISK ASSESSMENT ISSUES

- Particles >2 mm are removed
 - Safety considerations
 - Representative of actual exposures?
 - Available for analysis if required
- Grinding turns soil into talcum powder
 - Representative of actual exposures?
 - Misrepresents actual bioavailability?





RISK ASSESSMENT ISSUES



- **Derived for energetics**
 - Applicable to other analytes (i.e., metals, SVOCs, VOCs)?
- **Grinding** – increases metals concentrations
 - Due to bowl and puck?
 - Due to additional exposed surface area?
 - Can be duplicated for background samples
- **Does 95% UCL** based on 3 replicates make sense? (ProUCL won't let you do it)



RISK ASSESSMENT ISSUES

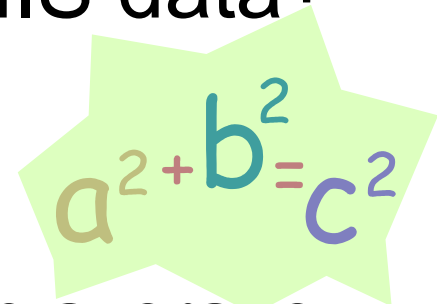
- What about hot spots?
 - Do we really care for chronic exposures?
 - Is exposure to acutely toxic concentrations possible?
 - All you get is the average concentration
 - No gradient of contamination...no spatial information





RISK ASSESSMENT ISSUES

- Can we combine discrete and MIS data?
 - MIS theory says “no”
 - Common sense says “no”
 - The average of an average and an average...
- Can we combine data from multiple SUs?
 - Statistics says “yes”...must be weighted
 - The average of an average and an average and an average...





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LABORATORY ISSUES





LABORATORY ISSUES

- Must have space to air dry MIS samples
- Must have grinding apparatus with adequate dust control to prevent cross-contamination
- Grinding generates heat (volatilization and thermal decomposition)
- Must have an SOP for the MIS sub-sampling



- **Laboratories that have demonstrated an acceptable MIS sub-sampling procedure:**
 - TestAmerica Denver of Arvada, CO
 - GPL Laboratories, LLC of Frederick, MD
 - APPL, Inc. of Clovis, CA
 - Analytical Laboratory Services, Inc. of Middletown, PA
 - TestAmerica Honolulu of Aiea, HI

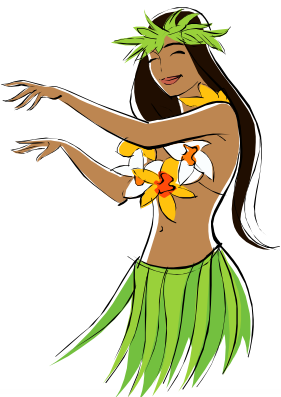


- **Laboratories requested (by USACE Districts) to have their sub-sampling procedure evaluated:**
 - Accutest Southeast of Orlando, FL (review almost complete)
 - TestAmerica West Sacramento of Sacramento, CA
 - TestAmerica Burlington of South Burlington, VT
 - Microbac Laboratories, Inc. of Marietta, OH



LABORATORY EXAMPLE

- **Lead analysis**, Expanded SI, SAFR, Hawai'i.
(*samples were not ground*)
 - QC samples. **RPDs** for the field samples and QC samples are **27%** for decision unit 3 and **28%** for decision unit 5 (less than the **30%** established for the project).
 - Field, dup and trip. **RSD** is **72%**, which indicates that the results for the three samples vary from the average result and that **sampling method may have caused sampling errors.**





LABORATORY SPLITS

- Results for the primary sample and the QC sample, **336 mg/kg** and **298 mg/kg** respectively.
- Laboratory split samples were prepared by two methods with 15 samples collected using each method.
 - Rotary Splitter
 - Spatula
- Rotary splitter: **280 mg/kg** to **2,820 mg/kg**.
- Spatula: **279 mg/kg** to **2,950 mg/kg**.
- Oooops!!!!!! We're working on it...



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REGULATORY “INTERFERENCE”



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“WE LOVE IT!!!!!!”

Hawai'i Dept. of Health (guidance)

Alaska Dept. of Environmental Quality (guidance)

USEPA Region 6

Texas Commission on Environmental Quality

New Mexico Environment Department



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“YOU WANNA DO WHAT?”

USEPA Region 3

USEPA risk assessors (generally)

Georgia Environmental Protection Dept.

Florida Dept. of Environmental Protection

Arkansas Dept. of Environmental Quality



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Now...be quiet and drink more koolaid...

QUESTIONS?

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